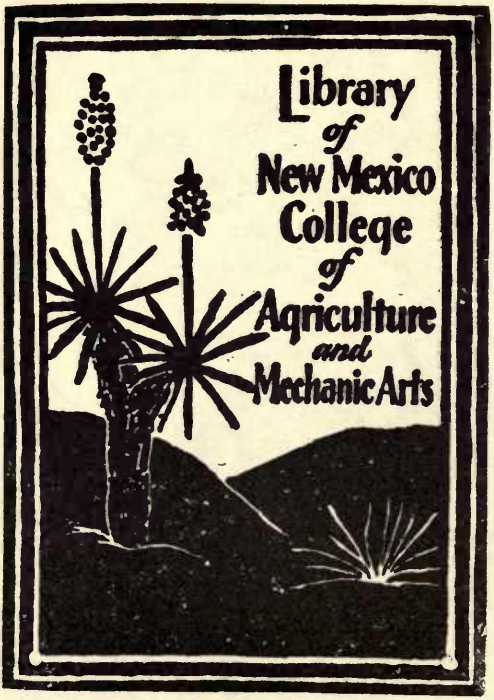

UNIVERSITY OF ILLINOIS,

Agricultural Experiment Station.

CHAMPAIGN, AUGUST, 1890.

BULLETIN NO. 11.

EXPERIMENTS WITH WHEAT.

In the following pages are given some of the more important results obtained during the past two years from experiments made with wheat. The report includes seven trials with fertilizers, in part made at the Station and in part made at other places, and two seasons' tests with regard to the preparation of the seed-bed, the quantity of seed sown, the time of sowing, and the effect of the time and manner of harvesting on the yield of wheat.

The trials with commercial fertilizers in the production of wheat do not indicate that their application will be found generally profitable in central Illinois. In an experiment made in 1888–9 on the light-colored clay soil of southern Illinois, the apparent increase from the use both of stable manure and commercial fertilizers was very marked and abundantly profitable. Three trials were made in three separate localities this season, and up to the time of the severe weather in March, the field notes indicated an appreciable effect from the use of stable manure and commercial fertilizers. How much this severe weather affected the results, the fertilized plats being the ranker and possibly proportionately more severely injured, can not be told. Although the per cent. of increase from the use of stable manure, cattle tankage, and superphosphate was often considerable, being as high as 92 per cent. in one case and in many cases 25 per cent. or more, still the total increase in yield was not sufficient to pay for the cost of the fertilizers used. Whether or not during a series of years the application of commercial fertilizers to the light-colored clay soil of southern Illinois can be made profitable in the production of wheat can be determined only by a series of carefully conducted experiments; but with the information so far obtained, it is

believed that the prospects are sufficiently good to make it desirable that as many farmers as may be in a position to do so should give the subject careful tests on a small scale. No farmer should use commercial fertilizers on a large scale unless he has more information than is given by these trials.

Fertilizers containing phosphoric acid generally produced the most effect, those containing potash the least. Good stable manure was generally equal to any other fertilizer.

The experiments indicate that sowing wheat in October is not a safe practice in this latitude.

It would seem that, between one and two bushels per acre, the rate of seeding affects the yield much less than other items in wheat culture.

Drilling wheat in plowed ground has given better yields than drilling in corn stalks or drilling in open ground prepared with a disk harrow. Rolling the ground after drilling did not injure the wheat this season, which was a severe one.

In the one trial made during a season favorable to wheat, no benefit was obtained from mulching wheat with straw at the rate of one and a quarter tons per acre.

In general, the riper the wheat the larger has been the yield from a given number of heads, and the larger the kernels. The experiments indicate that if the wheat were rather green, shocking and capping would result in a larger yield than harvesting without binding.

Experiment No. 61. Wheat, Effect of Fertilizers.

A test of the effect of fertilizers on wheat was made on an acre of land on the farm of Mr. E. E. Chester, near Champaign. The land had previously been in oats, three years in corn, pasture, clover meadow, and wheat.

May 8, 1888, an acre of winter wheat was divided into four plats, each one by forty rods, and fertilizers were sown broadcast, as shown in table.

Mr. Chester reported June 11th that the leaves of the wheat were broader and darker green on plats 1, 2, and 3 than on plat 4. July 8th he found plats 1, 2, and 3 riper than plat 4. July 13th the wheat was harvested, and August 3d and 4th it was weighed and threshed.

Mr. Chester believes that plat 1 was somewhat injured by a hedge one rod distant.

TABLE SHOWING KIND AND QUANTITY OF FERTILIZER USED, YIELD OF GRAIN AND STRAW.

Plat	Fertilizer.	Lb. of fertiliz'rs used per acre.	Bu. of grain per acre.	Lb. of straw per acre.	Increase or decrease in yield.	Value of increase	Cost of fertilizers.
1	Muriate of potash	100	16.8	1,500	—0.6	.....	.....
2	Muriate of potash Nitrate of soda..	100 100	20.5	1,800	+3.1	$2.33	$2.25
3	Nitrate of soda..	100	21.6	2,020	+4.2	3.15	4.00
4	None	....	17.4	1,680	... .	.....	.....

Experiment No. 62. Wheat, Effect of Fertilizers.

This test was made on an acre of ground on the Station lands during the seasons of 1888–9 and 1889–90. The tract was divided into one-tenth acre plats each 2 x 8 rods, which were fertilized similarly each season, except that plat 2 received a mulch of straw in 1888 only.

In 1888 the land was in corn, which was removed for ensilage, and for several years previous it was in clover. The land was probably of more than average fertility.

The stable manure, cattle tankage, and superphosphate were applied broadcast in the fall, after the land had been plowed and just before seeding. The seeding was done September 21, 1888, and September 16, 1889. The straw mulch was applied December 8, 1888. The muriate of potash and nitrate of soda were applied March 20, 1889, and April 1, 1890.

Field notes. April 15, 1889, no decisive differences were to be seen in the plats. Plats 7 and 8 seemed to be less vigorous that the other plats. Wheat on plat 1 appeared the largest. May 8, 1889, wheat on plats 2, 7, and 9 seemed the least vigorous; that on plat 7 the least of the three; that on plats 1 and 10 seemed the most vigorous; that on plat 1 more than on plat 10. May 14th, culms were well formed but there were no heads. Wheat on plat 1 was the largest; that on 2 and 7 the smallest. The wheat on the rest of the plats not appreciably different. May 20th, wheat on plats 1, 6, 9, 10, and 11 most fully headed; that on plats 2 and 7 least.

December 4, 1889, the wheat on plat 1 was larger and more vigorous than on the rest of the plats. No difference was discernible in the other plats. In general, the growth of wheat was rather weak. March 3, 1890, it was again noted that the wheat on plat 1 had made the strongest growth, while no appreciable difference was observed in the other plats. April 1, 1890, the wheat was all weak, having been severely injured during March. The wheat on plat 1 seemed killed more than on any of the other plats. The comparatively warm weather during the winter months caused a larger growth than is usual on all the plats and especially on plat 1, and the cold weather of March had a disastrous effect.

May 7, 1890, the stand on plats 2, 3, 4, 5, 6, and 10 appeared about the same; on plats 1 and 9 it was somewhat poorer; on plats 7 and 8 it was considerably poorer. June 3, 1890, the stand appeared poorer, and the wheat was less fully headed on plat 1 than on the other plats. The wheat was the smallest on plat 7.

Yield. The wheat was harvested July 2 and 3, 1889, and June 30, 1890, and threshed August 5–8, 1889, and July 18, 1890. The results are given below. They are not at all conclusive. The plats on which cattle tankage or superphosphate (both containing phosphoric acid) were applied yielded appreciably more than plat 7 on which no fertilizer was applied. The prices of commercial fertilizers vary, but the cost of the fertilizers per acre, as applied, was about $5 for cattle tankage and superphosphate, $4 for nitrate of soda, and $2.25 for muriate of potash. If it is assumed that the increased yield of plats 3 and 4 over plat 7 was due to the application of fertilizers, the fertilizers left a small profit at prevailing prices of wheat (75 to 80 cents per bushel). On the other hand, nothing had been applied to plat 2 except a light straw mulch in the fall of 1888. The mulch did not seem to have any effect during that season; and it hardly seems probable that it materially affected the result this sea-

son. If plats 3 and 4 are compared with plat 2, the increased yield did not pay for the cost of applying the fertilizer.

TABLE SHOWING FERTILIZERS USED, YIELD OF GRAIN AND STRAW, AND AVERAGE YIELD OF GRAIN FOR THE YEARS 1888-9 AND 1889-90.

Plat	Fertilizers.	1888-9.			1889-90.	
		Fertilizers used each year, per acre	Bu. of grain per acre.	Lb. of straw per acre.	Bu. of grain per acre.	Av. bu. gr. per a., two seasons.
1	Stable manure	*20 loads	37	4,600	15.1	26.1
2	†Oat straw mulch	2,500 lb.	33.3	4,150	23	28.2
3	Cattle tankage	400 lb.	37.9	4,900	23.8	30.9
4	Superphosphate	400 lb.	39.8	5,000	22.5	31.2
5	Superphosphate Nitrate of soda	400 lb. 100 lb.	39.5	4,700	23.7	31.6
6	Superphosphate Muriate of potash	400 lb. 100 lb.	37.7	4,250	19.8	28.8
7	None		30.	4,150	15.8	22.9
8	Nitrate of soda	100 lb.	33.3	3,900	17.3	25.3
9	Muriate of potash	100 lb.	35.2	4,000	14.3	24.8
10	Nitrate of soda Muriate of potash	100 lb. 100 lb.	40.2	4,800	21.8	31

* 38,450 lb. in 1888-9. † Used in 1888-9 only.

Experiment No. 69. Wheat, Effect of Fertilizers.

This experiment was undertaken by the Station on the light-colored soil of southern Illinois in 1888 at the suggestion primarily of Professor S. A. Forbes, State Entomologist, with the view of determining the effect of certain fertilizers in tiding a crop of wheat over an attack of chinch bugs. But, the chinch bugs having disappeared, the experiment has been carried forward to ascertain the direct effect of the fertilizers in the production of wheat. Four trials have been made—one in 1888-9 and three in 1889-90.

THE FIRST TRIAL was on the farm of W. W. Bowler, one and one-half miles south of Flora, Clay county. A tract containing two acres was divided into 8 plats each 2 x 20 rods. It had had the following crops: 1881-2, wheat; 1883, corn; 1884, oats; 1884-5, wheat; 1885-6, wheat; 1887, pasture; 1888, oats. In the spring of 1885 the wheat was plowed up and the tract was sown to millet. The tract appeared to be a particularly even piece of ground, and, taking all the years together, Mr. Bowler had not observed that one part was more productive than another. In view of the fact, however, that the yield of wheat and the yield of hay hereafter given decreased, in general, from plat 1 to plat 8, and that plats 1 to 5 yielded so much better than plats 6 to 8, he has suggested that as plats 1 to 5 were nearer the feed lots, more manure may have been spread on them in previous years. The suggestion was made after the yields were obtained, and is given that all possible chances of error may be known. The case illustrates a difficulty with which the experimenter in this line of work has to contend.

The kinds of fertilizers used are given in the table. The stable manure was spread just before plowing. The cattle tankage and superphosphate were spread broadcast just before seeding, and harrowed in. The nitrate of soda and muriate of potash were sown broadcast March 29, 1889. The wheat was sown September 27, 1888, the plowing having been done one week before.

Field notes. The ground was in fine condition when the wheat was sown, and Mr. Bowler reported that the wheat came up very well.

December 7, 1888, Mr. John Marten, of the State Entomologist's office, visited the wheat and made the following notes:

"The plat spread with stable manure is in fine condition, much ranker than any other. Wheat covers the ground well, and is of a good color. Contrast between this and the plat which received cattle tankage is quite sharp, and can be seen clear across the plats. Cattle tankage plat is next below the stable manure in condition and appearance. It is not so rank, but is in excellent condition. The superphosphate plats are below the cattle tankage plat in condition and appearance, but the contrast between them is not so great as that between the stable manure and the tankage. Wheat on them seems rather thin to winter well.

"Where no fertilizers were used the wheat shows the least growth, is quite poor in color, with the ends of the leaves generally dead or withered. The plat contrasts sharply with all the others."

May 24th, Mr. Bowler wrote:

"The wheat on plats 1, 2, 3, and 4 made a good growth in the fall, wintered well, and gives promise of a good stand. The wheat on plats 5, 6, 7, and 8 winter-killed so as to leave it thin on the ground and weak in the spring. Plat 1 is the best."

Yield. The wheat was harvested July 22d, and threshed from the stack August 8th, with results as given in the table. Owing to a mistake in the execution of the work, the separate yields of plats 5, 6, 7, and 8 can not be given with certainty, but only their combined yield. But as the fertilizers used on plats 6, 7, and 8 were put on in the spring after the wheat had been too severely injured by frost to be materially helped by them, the whole acre, for purposes of comparison, may be considered as not fertilized.

TABLE SHOWING FERTILIZERS, YIELD OF GRAIN AND STRAW, WEIGHT OF WHEAT.

Plat	Fertilizers.	Fertilizers used per acre.	Pounds of grain.	Bu. of grain per acre.	Lb. of straw per acre.	Lb. per bushel.	Wt. in grams of 1,000 ker. of wheat.
1	Stable manure ...	20 loads	439.5	27.25	2,740	62	36.5
2	Cattle tankage....	400 lb.	413			63	36.3
3	Superphosphate...	400 lb.	423			63	36.4
4	Superphosphate .. / Muriate of potash.	400 lb. / 100 lb.	360			63	35.7
5	None.....	.....					
6	Nitrate of soda ...	100 lb.					
7	Muriate of potash.	100 lb.	523.5	8.75	875	61	31.7
8	Nitrate of soda.... / Muriate of potash.	100 lb. / 100 lb.					

Yield of hay. In the fall of 1889, Mr. Bowler sowed plats 1 to 8 with timothy, sowing it alone as is customary in that part of the state. Throughout the year the superior growth of the timothy on plats 1 to 4 was noticeable. In the spring a coating of begasse from a sorghum mill

was put on plat 8. The hay was cut on each plat separately the morning of July 9, 1890, and was raked and shocked in the evening. The morning of July 11th it was weighed with the following results:

TABLE SHOWING YIELD OF HAY IN 1890 ON PLATS FERTILIZED FOR WHEAT IN 1888–9.

Plat	Fertilizers used on the wheat in 1888–9.	Pounds hay per plat, 1890	Pounds hay per acre, 1890
1	Stable manure	959	3,836
2	Cattle tankage	722	2,888
3	Superphosphate	788	2,976
4	Superphosphate Muriate of potash	549	2,196
5	None	421	1,684
6	Nitrate of soda	368	1,472
7	Muriate of potash	259	1,036
*8	Nitrate of soda Muriate of potash	323	1,292

* Begasse applied in 1890.

THE SECOND TRIAL was made at Mr. Bowler's in 1889–90 on four and one-half acres of land similar to that used the year before. The tract had been in cultivation 22 years, had had no manure, and had been in grass for seven or eight years, except four years ago when it was in oats. The tract was divided into 18 plats, each 2 x 20 rods. The land is rather level, plats 14 to 18 inclining to be wet.

August 14 to 18, 1889, the tract was plowed east and west and drainage ditches opened in same direction. September 13th, tract was disk-harrowed. September 20, 21, 1889, and April 12, 1890, fertilizers were applied as shown in the table. The wheat was drilled on September 23d.

Field notes. November 9, 1889, the wheat was examined by Mr. Bowler, who wrote: "All the wheat is doing well, but there is not that marked difference between that which had fertilizers and that which had none that I had expected to find. Plat 2 is the best, and plat 3 next best, but beyond that it is hard to tell the divisions of the plat by the appearance of the wheat."

April 10, 1890, a visit was made to the wheat, and although some wheat had been killed by freezing, the stand was found to be fairly good. The plats having stable manure, cattle tankage, or superphosphate were certainly better than those having no fertilizer, or having only a potash or nitrate fertilizer. Plat having stable manure was probably the largest and thickest, the cattle tankage plat next, and the superphosphate plat next. Plat 4 was very little poorer than plats 2 and 3, or plats 5 and 6; but plat 7 was distinctly poorer than plats 5 and 6, or 8 and 9. Plats 10 to 18 were smaller and thinner than plats 2 to 9, but no special difference could be seen between these plats.

The wheat was harvested June 24, 1890, when the following notes were taken: Plat 2 appeared better than plat 3. Plats 5 and 6 were distinctly better than plat 7, but did not appear much better than plat 4. Plat 8 was distinctly taller and thicker than plat 7. Plat 9 was taller than plat 8 and distinctly taller and thicker than plat 10. Plat 9 is the best in the field. Plats 10, 11, 12, and 13 are much alike. Plats 14 and 15 are taller than plats 10 and 13, or than plat 16. Plat 17 seems better than plats 16 or 18.

Yield. The wheat was threshed July 11, 1890, from the shock, with the results given in the table. The increase or decrease in yield from the

use of the fertilizers is computed by comparing with the average yield of the two nearest plats having no fertilizer. The value of the increase is computed at 75 cents per bushel; the cost of the fertilizers, at the following prices per hundred weight: Cattle tankage and superphosphate, $1.25; sulphate of potash, $1.50; and nitrate of soda, $4.

TABLE SHOWING FERTILIZERS, YIELD AND WEIGHT OF GRAIN, INCREASE, COST OF FERTILIZERS.

Plat	Fertilizers.	When applied.	Quantity applied per acre.	Yield of gr'n Bus. per a.	Wt. in grams of 1000 kern'ls	+ Increase or-decrease in y'ld	Per ct. of increase	Value of increase	Cost per acre of fertilizers.
2	Stable manure...	Fall ..	20 loads	15.7	33.3	+3.4	28	$2.55	?
3	Cattle tankage...	Fall ..	400 lb.	13.4	31.6	+1.1	9	0.83	$ 5.00
4	None.....		.....	13.7	32.1	.....	.....	.....	.....
5	Superphosphate..	Fall ..	400 lb.	12.6	32.1	+0.3	2	0.23	5.00
6	Superphosphate..	Fall ..	400 lb.	15.3	32.7	+3	25	2.25	8.00
	Sulphate of potash	Spring	200 lb.						
7	None		.....	10.9	30.9	.....	.....	.....	.....
8	Superphosphate..	Fall ..	400 lb.	17.1	32.3	+5	41	3.75	5.00
9	Superphosphate..	Fall ..	400 lb.	21.3	32.8	+9.2	76	6 90	11.00
	Sulphate of potash	Spring	200 lb.						
	Nitrate of soda...	Spring	100 lb.						
10	None		.....	13.2	30.3	.....	.....	.....	.....
11	Nitrate of soda..	Fall ..	100 lb.	10.7	27.6	—1.8	.....	.....	4.00
12	Sulphate of potash	Fall ..	200 lb.	10.9	29.5	—1.6	.....	.....	3.00
13	None		.....	11.7	28.9	.....	.....	.....	.....
14	Nitrate of soda..	Fall ..	100 lb.	15.5	29.1	+2.3	17	1.73	7.00
	Sulphate of potash	Fall ..	200 lb.						
15	Nitrate of soda...	Spring	100 lb.	15	29.8	+1.8	14	1.35	7.00
	Sulphate of potash	Spring	200 lb.						
16	None		.....	14.6	31.4	.....	.....	.....	.....
17	Nitrate of soda ..	Spring	100 lb.	15	30.9	+1.8	14	1.35	4.00
18	Sulphate of potash	Spring	200 lb.	12	30.1	—1.2	.....	.....	3.00

THE THIRD TRIAL was made on the farm of J. W. McCluer, in Marion county, three miles south of Farina. The tract contained two and one-fourth acres, and was divided into plats each 2 x 20 rods. The soil of this tract is believed, by Mr. McCluer, to be fully up to the average of tillable soil in that county, but it had had no manure applied to it for many years. It yielded good crops of oats in 1888 and 1889; was in corn in 1887, and in pasture six years before.

The tract was plowed about August 15th and September 16th, was prepared for seeding by disking and harrowing. Stable manure was spread on plat 3 and by mistake on about one-fifth of plat 2. September 20th the other fertilizers were sown broadcast, and the wheat drilled.

Field notes. November 3d, Mr. G. W. McCluer visited the tract and reported that plat 3 was larger than the other plats, and that plat 1 was larger than those not fertilized or those fertilized with superphosphate. January 3, 1890, Mr. J. W. McCluer wrote:

"The plats on which commercial fertilizers were used are better than those on which nothing was used. The difference is quite plain; but I cannot see any difference between the different kinds of commercial fertilizers. The plat on which stable manure was applied is far in advance of all the rest. It can be told from the others as far as it can be seen."

April 9, 1890, the wheat was visited and found to have been badly injured by freezing. The wheat where stable manure was applied was about one-half a stand,

and very much thicker and larger than on any of the other plats. The difference was very striking. On the other plats the wheat was about an eighth of a stand. There was a slight but appreciable difference in favor of the plats having commercial fertilizers over those having nothing. The plat having cattle tankage seemed a trifle stronger than those having superphosphate. The wheat was killed during March. Mr. McCluer says that when the wheat was at its best there was a marked difference in favor of the fertilized plats when compared with the unfertilized. The wheat was harvested June 26, 1890, when one reason for the better stand on plat 3 was apparent. It was partly timothy, which had been sown with the manure.

Yield. The wheat was threshed from the shock July 12, 1890, and yielded as given in the table. The value of the increase and the cost of the fertilizers are estimated on the basis given above. It was not intended to use plat 9 in comparing results, as it was next a hedge and therefore deemed unsuitable. Plats 8 and 9, however, were harvested together. The yield for the two plats is probably slightly lower than the yield from plat 8. It is not used in determining increase in yield.

TABLE SHOWING FERTILIZERS, YIELD AND WEIGHT OF GRAIN, INCREASE, COST OF FERTILIZERS.

Plat	Kinds of fertilizers.	Quantity used per acre.	Yield of grain. Bus. per acre.	Wt. in grams of 1000 ker.	Increase in yield.	Per cent. of increase.	Value of increase.	Cost per acre of fertilizer
1	Cattle tankage...	400 lb.	7.1	27.2	3.4	92	$2.55	$5.00
2	Stable manure on one-fifth	.....	5.5	27	1.8	49	1 35	?
3	Stable manure...	20 loads	7	29.7	3.3	90	2.48	?
4	None.....	.....	3.8	24.9	.....	.....	.....	.....
5	Superphosphate..	400 lb.	6.6	26.2	2.9	78	2 18	5.00
6	None.	.....	3.6	24.4	.....	.....	.....	.....
7	Superphosphate..	400 lb.	5.7	24.3	2	54	1.50	5.00
8&9	None.....	.....	3.3	.....	.....	.....	.....	.....

THE FOURTH TRIAL was made on the farm of A. M. and H. N. Woodward, one mile west of Odin, Marion county, which is cultivated by A. Barndt. The tract of two and one-fourth acres was divided into 9 plats each 2 x 20 rods. Plat 1, being next a row of trees, was not used. The tract had been in timothy meadow several years, and had had no manure applied to it so far as known. The land is comparatively high and level, requiring no drainage ditches.

The land was plowed about June 12, and again September 1, 1889. September 18th to 23d the seed-bed was prepared by harrowing both ways; stable manure and commercial fertilizers were spread; the tract was harrowed, and the wheat drilled.

Field notes. December 24, 1889, Mr. H. N. Woodward wrote:

"The wheat is looking well, and going into winter quarters in first-rate condition. It is very hard to tell which plats—the stable manure, cattle tankage, or superphosphate—look best. All show, in a marked degree, the benefit of the fertilizers. It is noticeable to the very line where the fertilizers were applied. The wheat has a better growth and stronger appearance."

April 9, 1890, the wheat was visited, and it was found that the plats having fertilizers were distinctly larger that those not receiving fertilizers. The stand seemed to be

better also. The cattle tankage plat seemed best, the superphosphate plats next; but the plat having stable manure seemed more irregular and less distinct from adjoining plats. The wheat was harvested June 23, 1890, at which time the difference between the plats was very slight, consisting merely in the fertilized plats having a better stand. Neither the growth of the straw nor the heads seemed to have been affected.

Yield. The wheat was threshed from the shock on July 3d, with the results as given in the table. For method of preparing table, see second trial, p. 343.

TABLE SHOWING FERTILIZERS, YIELD AND WEIGHT OF GRAIN, INCREASE, COST OF FERTILIZERS.

Plat	Fertilizers.	Quantity used per acre.	Bu. of grain per acre.	Wt. in grams of 1000 ker.	Increase in yield.	Per cent. of increase.	Value of increase.	Cost per acre of fertilizer
1	Stable manure...	20 loads	10.5	34.8	1.9	22	$1.43	?
2	None.....	.....	9.1	31.7	.....	.....	.....	.....
3	Cattle tankage.	400 lb.	10.1	33.1	1.5	17	1.13	$5.00
4	None.....	.....	8.1	32.1	.....	.....	.....	.....
5	Superphosphate .	400 lb.	11.1	33.4	2.5	29	1.88	5.00
6	None.....	.....	9	33	.....	.....	.....	.....
7	Superphosphate .	400 lb.	12.9	33	2.6	25	1.95	5.00
8	None.....	.....	11.5	33.6	.....	.....	.....	.....

The table and diagram combined, on following page, give a summary of most of the experiments with fertilizers upon wheat.

Experiment No. 63. Wheat, Method of Soil Preparation.

Two trials have been made on the Station grounds, one in 1888–9 and one in 1889–90.

In the first trial 1.1 acres of wheat were sown in standing corn, the land having been in mammoth clover before. The corn yielded at the rate of 78 bushels per acre. About 10 rods distant, where corn had been grown and removed for ensilage, the land having been previously treated similarly, three plats were laid off, each 2x8 rods. One was plowed, rolled, disked, harrowed, and rolled; one was disked twice without plowing; and to one nothing was done.

The wheat was drilled, September 22d, in the standing corn at the rate of a little less than one and one-quarter bushels, and on the other plats at little more than that quantity. Reference to *Experiment No. 65, Quantity of Seed per Acre,* will show that this did not materially affect the result.

In the first part of the season the wheat sown in the corn stubs, without any preparation of the seed-bed, looked the best, while that in the standing corn looked as well as the other plats. By spring the wheat in the standing corn looked distinctly smaller and thinner, while the wheat sown in the corn stubs looked better than that on the plowed land. Before harvest, however, that on the plowed land looked the largest.

DIAGRAM SHOWING EFFECT OF FERTILIZERS UPON YIELD OF WHEAT.

Fertilizer per acre.		Yield of wheat per acre.	
Name.	Qu'ntity	Bu.	One bu. to one-tenth inch.
Station grounds, 1889–90.			
Stable manure...	20 loads	15.1	
*None.....	.....	23	
Cattle tankage...	400 lb.	23.8	
Superphosphate..	400 lb.	22.5	
Superphosphate . 400 lb. / Nitrate of soda.. 100 lb.		23.7	
Superphosphate . 400 lb. / Muriate of potash 100 lb.		19.8	
None.....	.....	15.8	
Nitrate of soda..	100 lb.	17.3	
Muriate of potash	100 lb.	14.3	
Nitrate of soda.. 100 lb. / Muriate of potash 100 lb.		21.8	
Flora, Clay Co. 1888–89.			
For kind and quantity see p. 341	.....	27.2	
None, see p. 341.	.....	8.75	
Flora, Clay Co., 1889–90.			
Stable manure...	20 loads	15.7	
Cattle tankage...	400 lb.	13.4	
None.....	.....	13.7	
Superphosphate..	400 lb.	12.6	
Superphosphate.. 400 lb. / Sulphate of p'tash 200 lb.		15.3	
None.....	....	10.9	
Superphosphate..	400 lb.	17.1	
Superphosphate. 400 lb. / Sulphate of p'tash 200 lb. / Nitrate of soda .. 100 lb.		21.3	
None.	.....	13.2	
Nitrate of soda..	100 lb.	10.7	
Sulphate of p'tash	200 lb.	10.9	
None.....	.....	11.7	
Nitrate of soda .. 100 lb. / Sulphate of p'tash 200 lb.		15.5	
Nitrate of soda .. 100 lb. / Sulphate of p'tash 200 lb.		15	
None.....	. .....	14.6	
Nitrate of soda ..	100 lb.	15	
Sulphate of p'tash	200 lb.	12	
Marion Co., near Farina, 1889–90.			
Cattle tankage...	400 lb.	7.1	
Stable manure...	20 loads	7	
None.....	.....	3.8	
Superphosphate .	400 lb.	6.6	
None.....	.....	3.6	
Superphosphate .	400 lb.	5.7	
Odin, Marion Co., 1889–90.			
Stable manure...	20 loads	10.5	
None.....	.....	9.1	
Cattle tankage...	400 lb.	10.1	
None.....	.....	8.1	
Superphosphate .	400 lb.	11.1	
None.....	.....	9	
Superphosphate .	400 lb.	12.9	
None.....	.....	11.5	

* Mulch of oat straw, 2,500 lb., 1888–89.

The wheat ripened about equally, was harvested July 2 and 3, 1889, and threshed from the shock July 29th and 30th, with the following results:

TABLE SHOWING SOIL PREPARATION, YIELD OF WHEAT AND STRAW.

Plat.	Soil preparation.	Yield per acre.	
		Grain, bu.	Straw, lb.
12, 13	Drilled in standing corn, no other preparation	22.6	2,350
14	Drilled in plowed ground	42	5,500
15	Drilled in corn stubs, twice disked	39.1	4,300
16	Drilled in corn stubs, no other preparation	39.2	4,800

The second trial was made in 1889–90, on the 1.1 acres where wheat was drilled in standing corn the year previous. The tract was divided into four plats. On two of the plats the stubble was burned. One of these and one on which the stubble was not burned were plowed about six inches deep. The plowed plats were rolled, disked, harrowed, and rolled before drilling the wheat. The other plat on which the stubble was burned was disked six times before drilling. Each plat was drilled September 14, 1889, at the rate of about one and one-half bushels per acre. It was intended to sow wheat on the unplowed plat on which stubble was not burned, but it was found impracticable to prepare the seed-bed on account of the quantity of stubble.

The wheat killed out much worse on the plat which was plowed and the stubble not burned than on the other plats. It may be questioned whether this was due entirely to the method of preparing the seed-bed, as the ground was somewhat lower on this plat.

The plats were harvested June 30th and threshed July 17th, with the following results:

TABLE SHOWING SOIL PREPARATION AND YIELD OF WHEAT.

Kind of soil preparation.	Yield of grain. Bu. per acre.
Plowed, stubble burned	26
Plowed, stubble not burned	10.5
Disked only, stubble burned	17.9

Experiment No. 65. Wheat, Quantity of Seed per Acre.

This experiment was tried in 1888–9 and in 1889–90. The land used in 1888–9 was in corn one year, subsequent to being in mammoth clover for several years. Four plats, each 2 x 6 rods, were drilled at the rate of 4, 5, 6, and 8 pecks of wheat per acre September 22, 1888. The land had just previously been plowed, rolled, disked, harrowed, and rolled.

The land used in 1889–90 had been used as a nursery for some years, and during the season of 1889 was in sweet fodder corn. Five plats, each 2 x 4 rods, were drilled at the rate of 3, 4, 5, 6, and 8 pecks of wheat per acre September 17, 1889. The land had just previously been plowed, rolled, disked twice, harrowed, and rolled.

No difference was noticed between plats at any time except that due to the thickness of seeding.

The following table gives the yield of grain in bushels, and the straw in pounds per acre.

TABLE SHOWING AMOUNT OF SEED, AND YIELD OF WHEAT AND STRAW.

Number of pecks sown per acre.	Yield per acre.			
	1888-9.		1889-90.	
	Grain, bu.	Straw, lb.	Grain, bu.	Straw, lb.
3	.....	.....	24.6	2,215
4	36.2	4,560	28.2	2,620
5	38.3	4,700	26.3	2,740
6*	36.3	4,750	24.5	2,200
8	35.4	4,540	28.3	2.740

* In 1889 a plat adjacent to this was drilled at the same rate and afterwards rolled. This plat yielded at the rate of 26.5 bushels per acre.

Experiment No. 66. Wheat, Time of Sowing.

The character of the two seasons during which this experiment has been tried, has materially influenced the results. The land used was similar to that used in *Experiment No. 65*.

In 1888, three plats, each 2 x 6 rods, and in 1889, four plats, each 4 x 4 rods, were drilled at the rate of 6 pecks per acre at the date specified in the table. In 1888, the land was plowed and rolled three days before the first seeding, and each plat was disked, harrowed, and rolled just before each seeding. In 1889, the land was plowed one day before the first seeding, and each plat was rolled, disked twice, harrowed twice, and rolled just before seeding.

Field notes. December 12, 1888, the first seeding was strong and vigorous, covering the ground well; the second seeding was only moderate in size; the last seeding was small and weak.

March 20, 1889, the plats looked very similar. May 14th the wheat of the first two sowings was not appreciably different, while the last was somewhat smaller.

December 4, 1889, there was an appreciable difference in the growth of the wheat of each plat. The first seeding was strong and vigorous; the last very weak. The least difference was between the second and third seedings. March 3, 1890, the larger growth was on the first seeding. The second and third seedings had made a fair growth while the last seeding was very weak, being partly killed. The subsequent cold weather in March injured it further, and also injured the third seeding considerably more than the second.

Yield. The following table gives the yield of grain in bushels and straw in pounds per acre:

TABLE SHOWING DATE OF SOWING, AND YIELD OF GRAIN AND STRAW.

Date of sowing.	1888-9.			Date of sowing.	1889-90.		
	Grain, bu. per acre.	Straw, lb. per acre.	Wt. in grams of 1000 ker'ls.		Grain, bu. per acre.	Straw, lb. per acre.	Wt. in grams of 1000 ker'ls.
				Sept. 12	32.4	3,750	34.3
Sept. 22	38.2	4,570	36.4	Sept. 23	29.1	3,170	34.5
Sept. 29	40.4	4,505	34.8	Oct. 4	20.8	2,450	33.6
Oct. 8	36.1	3,905	33.9	Oct. 15	12.1	1,710	30

Experiment No. 53. The Effect of the Time and Manner of Harvesting on the Yield of Wheat.

The object of this experiment was—

1. To ascertain at what period of growth the largest yield of grain could be obtained.

2. To ascertain whether any of the substances of the straw passed into the kernel after it was cut, and under what conditions this best took place, if at all; so as to determine whether there were any advantages in shocking over cutting the grain loose and allowing it to dry quickly, other than those relating to the economical handling of the crop.

The chemical composition and milling qualities of the wheat have not been studied. The results given relate to the yield only.

General Statement of Results.

1. The figures obtained are not entirely satisfactory, inasmuch as they indicate that the errors incident to the execution of the method are considerable.

2. In general there was a continuous increase in the air-dry weight of the whole plant, roots excepted, from the first period when the kernels were small and undeveloped, until the last period when the kernels were hard and dry.

3. In general there was a continuous increase in yield of grain from a given quantity of straw from the first until the last period.

4. With more uniformity, there was an increase in the weight of a given number of kernels from the first until the last period.

5. The increase in yield and size of kernel was most rapid from the first to the third periods, up to the time when the kernels crushed with difficulty between the thumb and finger.

6. The increase was decided and of economic importance up to the fourth period, when the kernels indented under pressure of the thumb nail.

7. Between the fourth period and when the wheat was dead ripe, kernels hard and dry, the results, while conflicting, may fairly be said to indicate a slight increase.

8. These results prove beyond question that at the earlier stages of seed formation a considerable transfer of material from the straw to the kernel may occur after cutting, if the wheat is placed in conditions similar to the shocking and capping of bound sheaves.

9. Whether or not, at the later stages of seed growth, there is an increase of weight of the kernels after the plant is cut is not proved by these experiments.

10. So far as getting the maximum yield of wheat is concerned, the results indicate that it is better to allow the wheat to get nearly, if not entirely, ripe and that, if it be necessary to cut at a much greener stage, shocking and capping would probably be beneficial.

Method of Procedure.

Both seasons twelve five-pound samples* of growing wheat were cut weekly at dates specified. The heads of four samples were removed immediately, both straw and heads being afterwards dried under shelter. Four samples were dried under shelter in the same room as the preceding four, in imitation of shocked grain. Four samples were spread on the ground in the sun one week, or until thoroughly air-dry. About one month after the last samples were cut, the samples having been drying during this period in the same room, the number of heads or culms in each sample was ascertained, the kernels threshed and cleaned, and the weight of the straw and chaff determined.

Only a summary of the results is given, each number in the table being an average of the four samples taken. In determining the weight of the kernels of 100 heads of wheat, about 30,000 heads of wheat were weighed and counted each season.

Tabular Results.

The first table on p. 351 gives the date of cutting, the stage of ripeness when cut, the weight of the kernels, the weight of the straw and chaff, and the total weight of 100 culms of wheat when heads were removed immediately, when dried in the shade without removing heads, and when dried in the sun, at the five weekly periods for the years 1888 and 1889. The results are based on the theory that for any given date the total weight of a given number of culms would be the same, and that the increase in weight from one period to another represents a corresponding increase in growth.

An examination of the table will show that this has not been found strictly true, indicating that the samples cut at a given date varied in ripeness or in growth. Although the numbers in the table represent, usually, the average of twenty pounds of fresh substance, the variation is often considerable. The variations of the samples which were dried in the sun are partly due, however, to errors in manipulation. In drying on the ground in the sun, the samples, especially during the later cuttings, were subject to loss on account of the attacks of mice and birds, but while the later cuttings which were dried in the sun are felt to be untrustworthy, the earlier cuttings are believed to be fairly trustworthy. It is thought, therefore, that with this explanation it is better to give all the figures as obtained. The weight of a given number of kernels, as stated in a later table, would not be affected materially, probably, by the losses mentioned.

The second table, p. 351, gives the weight in ounces of 1,000 kernels of air-dry wheat under the different conditions and at the periods named:

This is probably a more satisfactory method of comparing results, as there is but little opportunity for errors in manipulation and a full opportunity for verification of results. There is a substantial uniformity of results both seasons by this method. The ripened kernels were 32 per cent. heavier in the same variety in 1889 than in 1888.

* The last week's cutting in 1888 was 2.5 lb., and it was 2 lb. in 1889.

TABLE SHOWING WEIGHT IN OUNCES OF KERNELS, STRAW, AND CHAFF, AND TOTAL WEIGHT, AIR-DRY, OF 100 CULMS OF WHEAT AT DATES AND UNDER CONDITIONS GIVEN.

No.	Date.	Stage of ripeness.	Wt. of kernels of 100 heads of wheat.			Wt. of straw and chaff in 100 culms of wheat.			Total wt. of 100 culms of wheat.		
	1888.		Heads removed.	Dried in shade.	Dried in sun.	Heads removed.	Dried in shade.	Dried in sun.	Heads removed.	Dried in shade.	Dried in sun.
1	June 19th	Kernels mostly small and undeveloped, upon pressure yielding a watery exudation	0.48	1.01	0.9	5.72	5.45	6.37	6.2	6.46	7.27
2	June 26th	Kernels in milk stage, when crushed yielding a thick milky substance	1.32	1.75	1.71	6.07	5.85	6.01	7.39	7.6	7.72
3	July 3d	Ripening unevenly, averaging dough stage	2.32	2.08	1.85	5.61	5.29	5.49	7.93	7.37	7.34
4	July 10th	Kernels indent under pressure of thumb nail	2.4	2.43	2.44	6.16	5.71	5.46	8.56	8.14	7.9
5	July 17th	Ripe, kernels hard and dry, straw yellow and dry	2.57	2.5	2.36	6.27	6.05	6.	8.84	8.55	8.36
	1889.										
1	June 11th	Kernels undeveloped and watery. Leaves and stems green	0.27	0.5	0.31	5.58	6.02	6.15	5.85	6.52	6.46
2	June 18th	Kernels in milk. Lower leaves dry, lower part of stem becoming dry	0.82	1.35	1.01	5.48	5.87	6.15	6.3	7.22	7.16
3	June 25th	Kernels in dough stage, crushing between thumb and finger with difficulty	1.73	1.87	1.64	5.37	4.88	5.26	7.1	6.75	6.90
4	July 2d	Kernels vary from dough to ripe. Leaves dry. Stems yellow. Nodes green	2.3	2.31	2.19	4.86	4.79	3.19	7.16	7.1	7.38
5	July 9th	Mostly ripe. Kernels not indenting. Stems and leaves, and nodes mostly dry	2.34	2.25	*1.94	5.05	4.96	*4.97	7.39	7.21	*6.91

* Injured by mice and birds.

The heaviest weights, both of the kernels from 100 culms of wheat and of 1,000 kernels, were always obtained from the last cutting, when

TABLE SHOWING WEIGHT IN OUNCES OF 1,000 KERNELS OF WHEAT, AIR-DRY.

Period.	1888.			1889.		
	Heads removed.	Dried in shade.	Dried in sun.	Heads removed.	Dried in shade.	Dried in sun.
1	0.29	0.48	0 42	0.24	0.31	0.25
2	0.60	0.71	0.7	0.61	0.71	0.62
3	0.92	0.95	0.77	0.92	1.09	1.02
4	0.95	0.91	0.92	1.23	1.22	1.23
5	1.00	0.91	0.93	1.31	1.23	1.21
Average...	0.752	0.792	0 748	0.862	0.912	0.865

the heads were removed immediately. Taking these weights as the standards, the relative weights of the kernels from 100 culms, and of 1,000 kernels from each of the cuttings, cured in each of the ways described, have been computed in per cents. of the standards, and the per cents. are given in the following table:

TABLE SHOWING RELATIVE WEIGHT OF KERNELS OF 100 CULMS OF WHEAT AND OF 1,000 KERNELS, IN PER CENTS. OF STANDARDS.

Period.	Date of cutting. 1888.	Relative wt. (air dry) of kernels of 100 culms of wheat.				Relative wt. (air-day) of 1,000 kernels of wheat.			
		Heads removed	Dried in shade.	Dried in sun.	Average	Heads removed	Dried in shade.	Dried in sun.	Average
1	June 19th	19	39	35	31	29	48	42	40
2	June 26th	51	60	67	59	60	71	70	67
3	July 3d.	90	81	72	81	92	95	77	88
4	July 10th	93	95	95	94	95	91	92	93
5	July 17th	100	97	92	96	100	91	93	95
	Average.	70.6	74.4	72.6		75.2	79.2	74.8	
	1889.								
1	June 11th	12	21	13	15	18	24	19	20
2	June 18th	35	58	43	45	47	54	47	49
3	June 25th	74	76	70	73	70	83	78	77
4	July 2d	98	99	94	97	94	93	94	94
5	July 9th	100	96	*83	93	100	94	92	95
	Average.	63.8	70	60.6		65.8	69.6	66	

* Injured by mice and birds.

The numbers showing the relative weight of kernels of 100 culms of wheat should agree with the numbers showing the relative weight of 1,000 kernels of wheat, provided there are no errors in manipulations, unless kernels were formed after the first cutting. If kernels were thus formed, it may be a possible explanation of the fact that the relative weight of 1,000 kernels was higher in the earlier cuttings than the relative weight of the kernels of 100 culms of wheat.

This table not only shows concisely the general trend of the results, but also the extent to which the results may be considered trustworthy. It merits a close inspection by any one interested in the subject.

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All communications intended for the Station should be addressed, not to any person, but to the

AGRICULTURAL EXPERIMENT STATION, CHAMPAIGN, ILLINOIS.

The bulletins of the Experiment Station will be sent free of all charges to persons engaged in farming who may request that they be sent.

SELIM H. PEABODY,
President Board of Direction.